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in der Umweltplanung | Environmental Planning

Technische Universität Berlin

Multisource Data for ecosystem monitoring

Special Session

Mathieu Fauvel & Michael Förster

Herzlich Willkommen. Bienvenue. Welcome.

Outline

Impact of multi-temporal research on ecosystem application

Added value of multisource classification

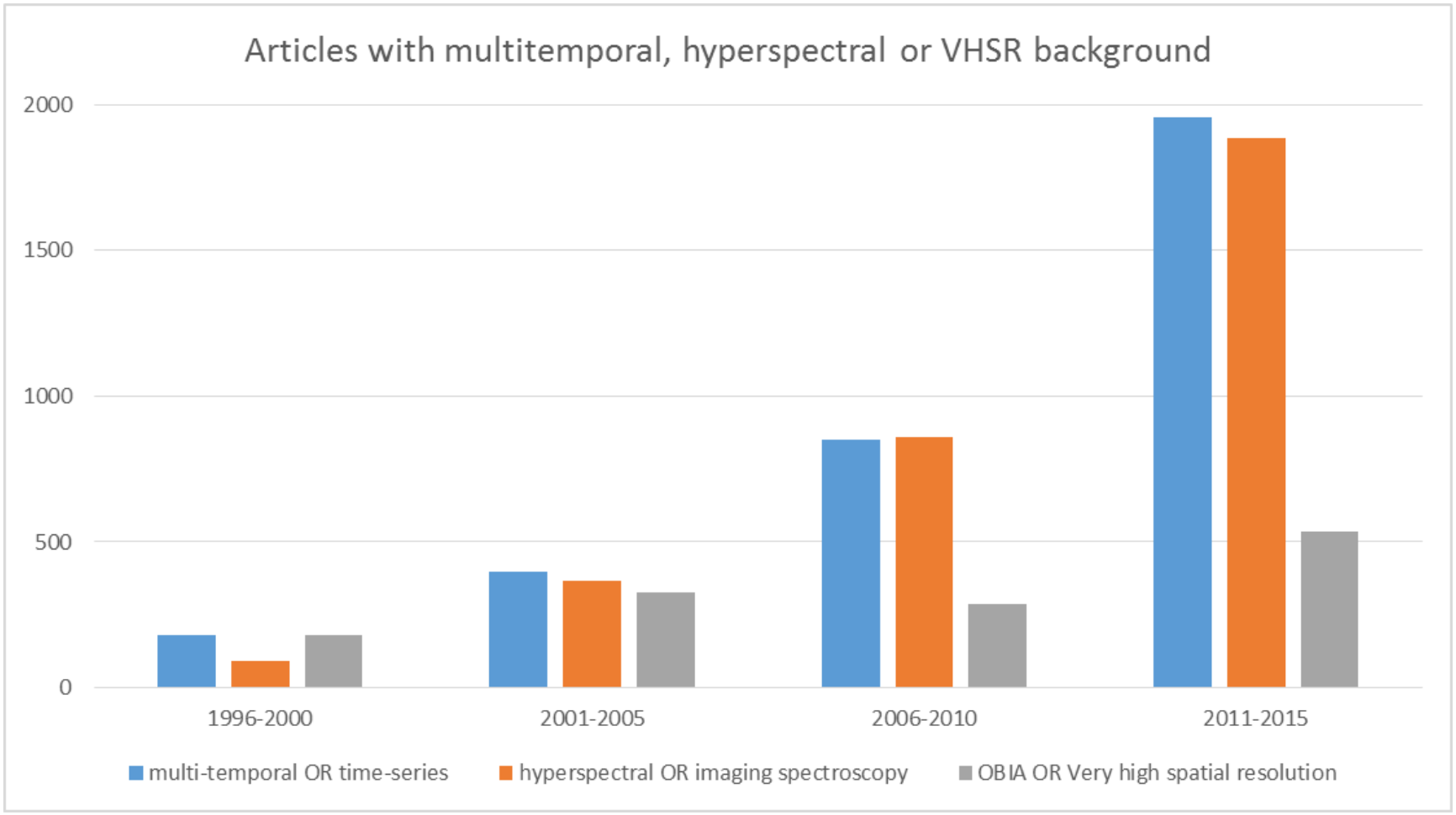
Requirements for efficient analysis of ecosystems by multi-temporal remote sensing

Evaluating the Temporal Stability of Synthetically Generated Time-Series

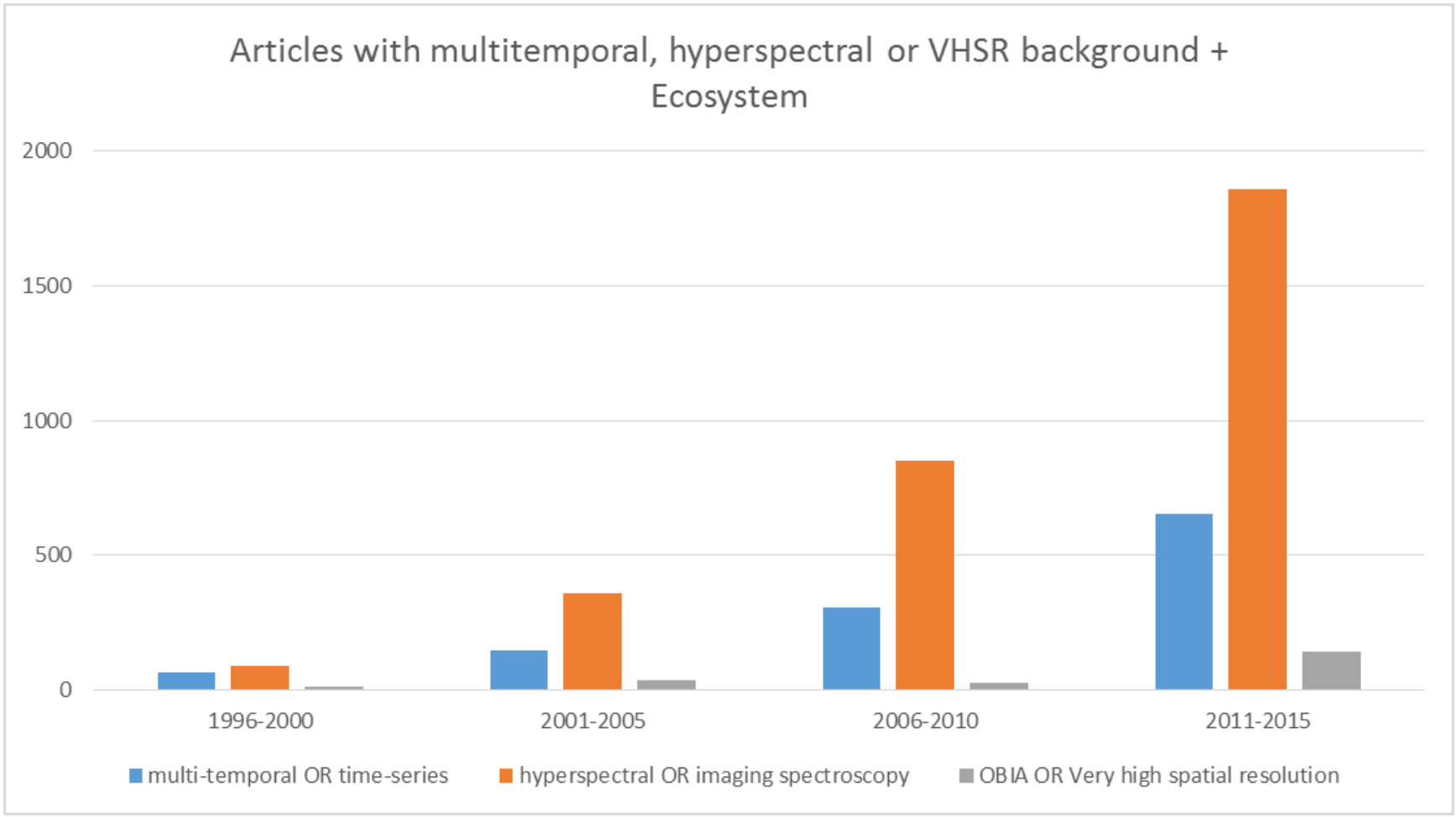
Main Question – Reasons for differences

Pre-Processing	feature selection	segmentation	filtering
Features	1st derivation continuum removed	texture scale-related	start of season end of season
Target	ecosystem inventory	ecosystem structure	ecosystem function
Algorithms	*Support Vector Machines* *CART-Approaches (e.g. Random Forest)*		

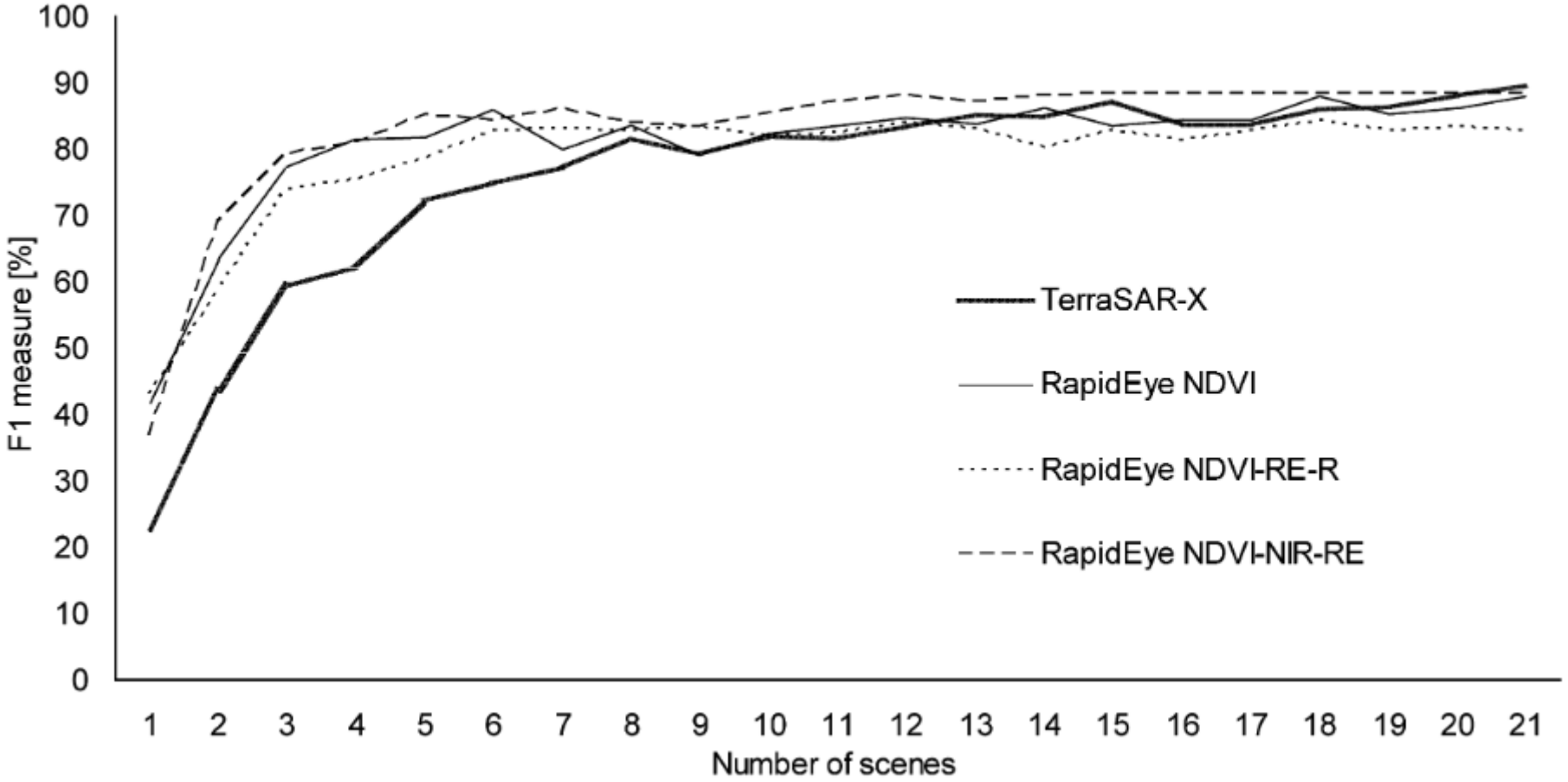
Scientific Impact of Resolutions



Scientific Impact of Resolutions

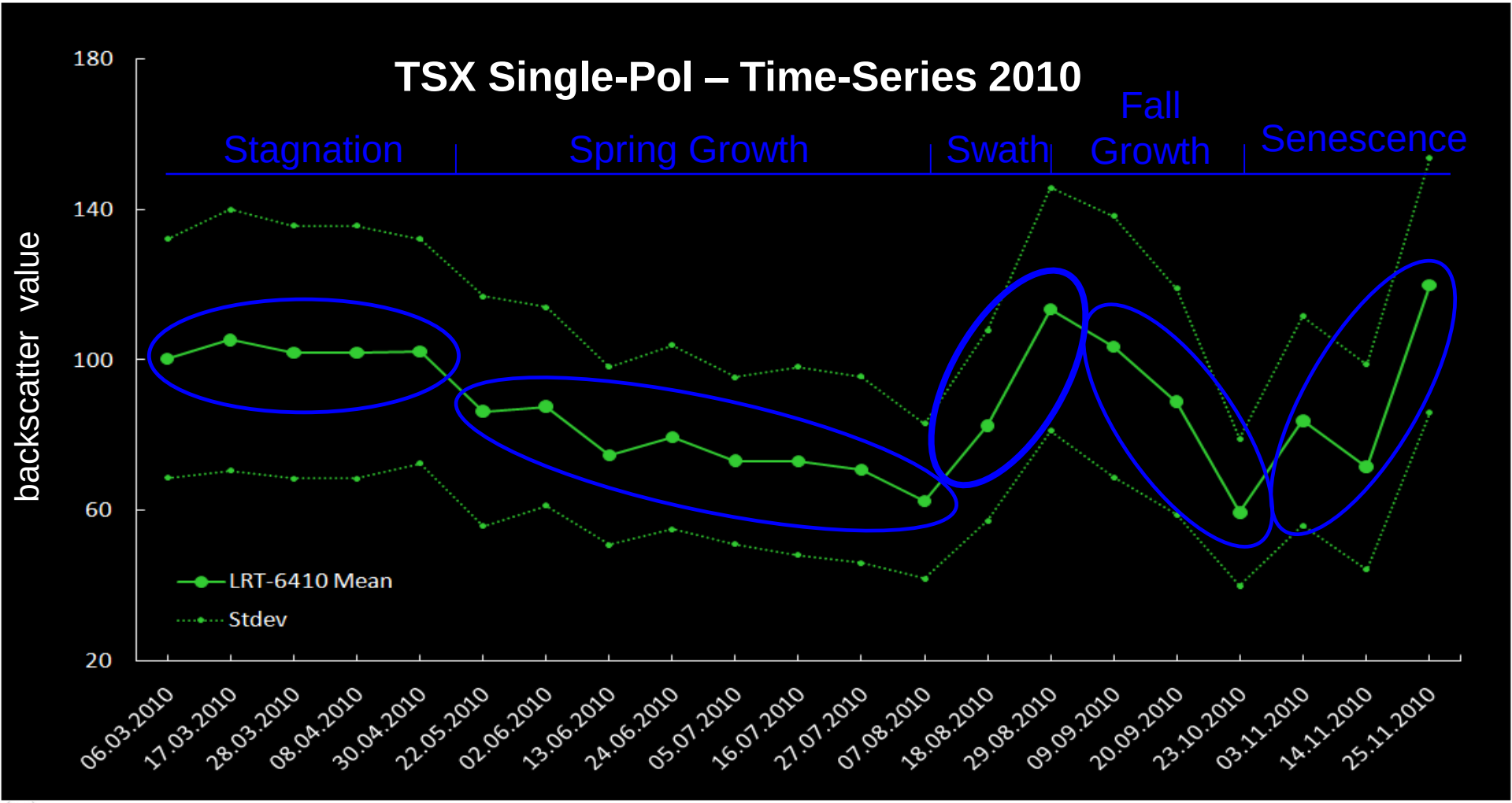


Added Value of Multitemporal & Multisource Classification



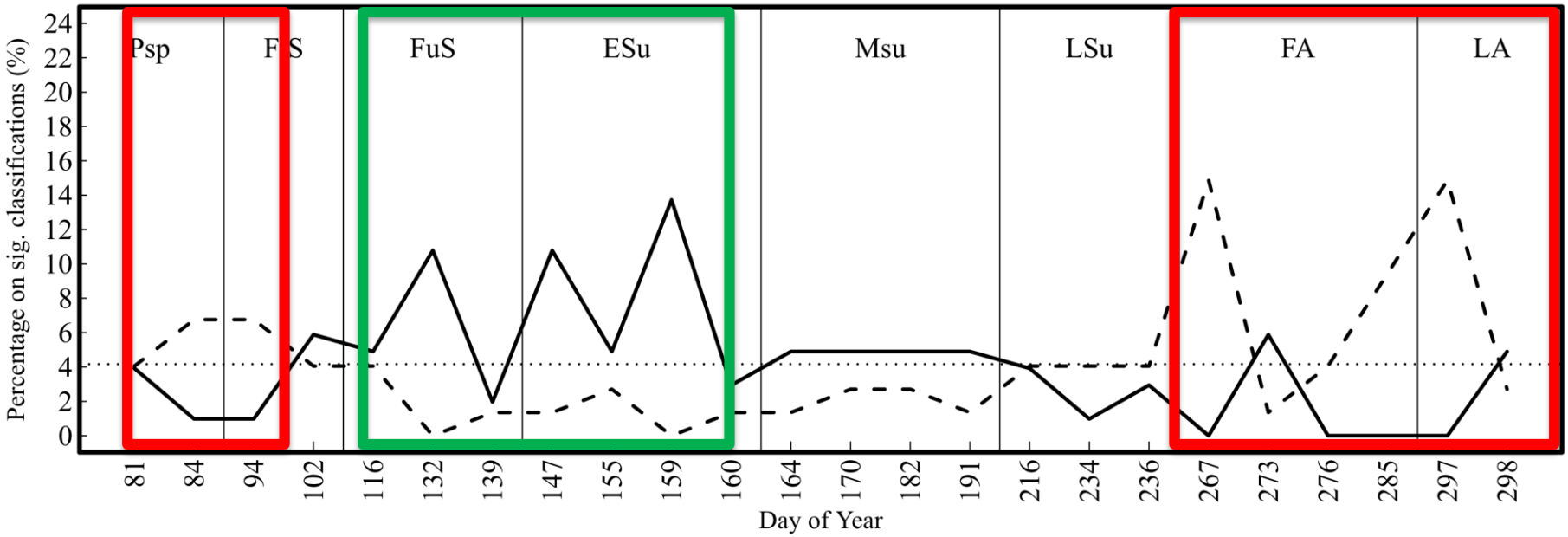
Schuster, C., Schmidt, T., Conrad, C., B., K., & Förster, M. (2015). Grassland Habitat Mapping by Intra-Annual Time Series Analysis - Comparison of RapidEye and TerraSAR-X Satellite Data. *International Journal of Applied Earth Observation and Geoinformation, 34, 25-34*

SAR Information for specific multitemporal analysis



Schuster, C., Ali, I., Lohmann, P., Frick, A., Förster, M., & Kleinschmit, B. (2011). Towards Detecting Swath Events in TerraSAR-X Time Series to Establish NATURA 2000 Grassland Habitat Swath Management as Monitoring Parameter. *Remote Sensing, 3, 1308-1322*

How many acquisitions and what seasonal origin are optimal?



Psp = Pre-Spring,
FiS = First Spring,
FuS = Full Spring,
ESu = Early Summer,
Msu = Midsummer,
LSu = Late Summer,
FA = Full Autumn,
LA = Late Autumn

Schmidt, T., Schuster, C., Kleinschmit, B., & Förster, M. (2014). Evaluating an Intra-Annual Time Series for Grassland Classification—How Many Acquisitions and What Seasonal Origin Are Optimal? *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 7, 3428-3439*

Requirements for Multitemporal Ecosystem Analysis

- large-scale coverage
- freely available
- high geometric resolution (30 m or finer)
- high repetition rate (often just a few days)
- long time-series (often decades)
- availability of equidistant data (as composites)
- calibration / validation data

MODIS

Landsat

Sentinel-2

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Evaluating the Temporal Stability of Synthetically Generated Time-Series for Crop Types in Central Germany

Michael Förster, Markus Möller, Feng Gao, Tobias Schmidt, Philipp Gärtner, Birgit Kleinschmit

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Motivation

- temporal and spatial data fusion is still required for different ecosystem applications
- the Spatial and Temporal Adaptive Reflectance Fusion Model (STARFM) is one of the most successful ones (Gao et al. 2006)
- Chen et al. (2015) showed that a more complex landscape creates higher prediction uncertainty
- this is the case for agricultural areas

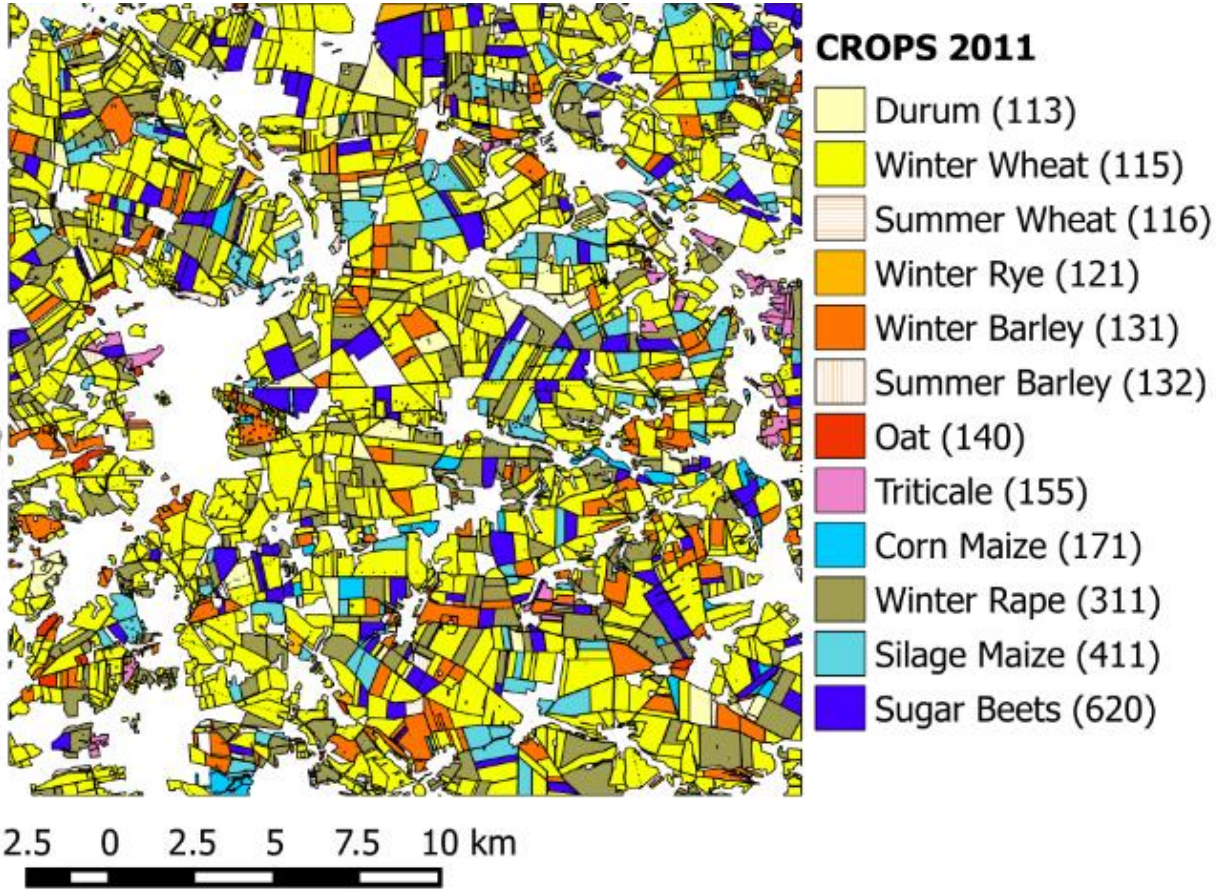
This Study is evaluating a typical STARFM product for different crops, based on a RapidEye time-series.

B. Chen, B. Huang, and B. Xu, "Comparison of Spatiotemporal Fusion Models: A Review," *Remote Sensing,* vol. 7, pp. 1798-1835, 2015.

Gao, F., Masek, J., Schwaller, M., & Hall, F. (2006). On the blending of the Landsat and MODIS surface reflectance: Predicting daily Landsat surface reflectance. *Ieee Transactions on Geoscience and Remote Sensing, 44, 2207-2218*

Study Area

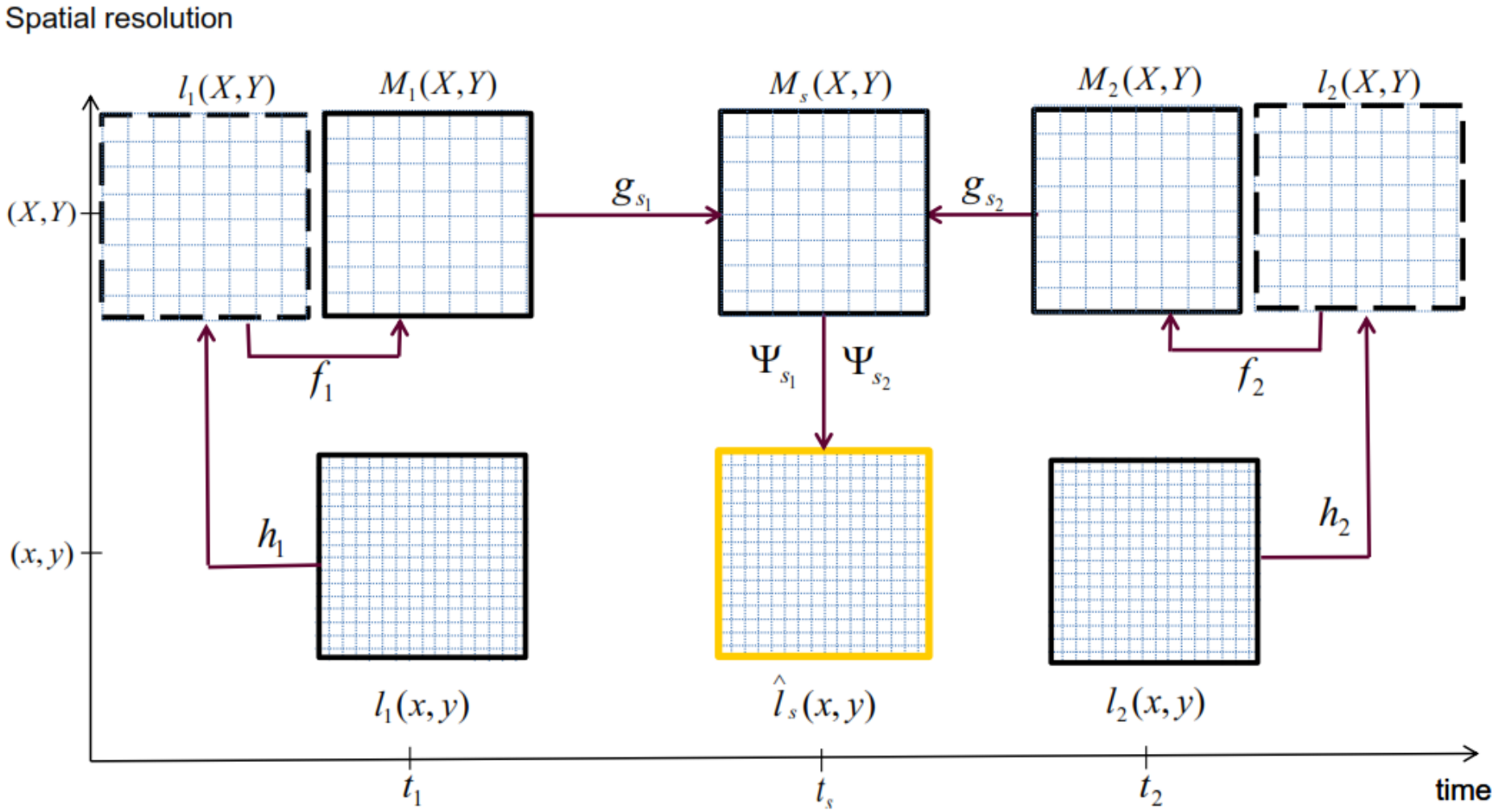

GERMANY
Saxony-Anhalt
Halle


CROPS 2011
Durum (113)
Winter Wheat (115)
Summer Wheat (116)
Winter Rye (121)
Winter Barley (131)
Summer Barley (132)
Oat (140)
Triticale (155)
Corn Maize (171)
Winter Rape (311)
Silage Maize (411)
Sugar Beets (620)
2.5 0 2.5 5 7.5 10 km

Data (for 2011)

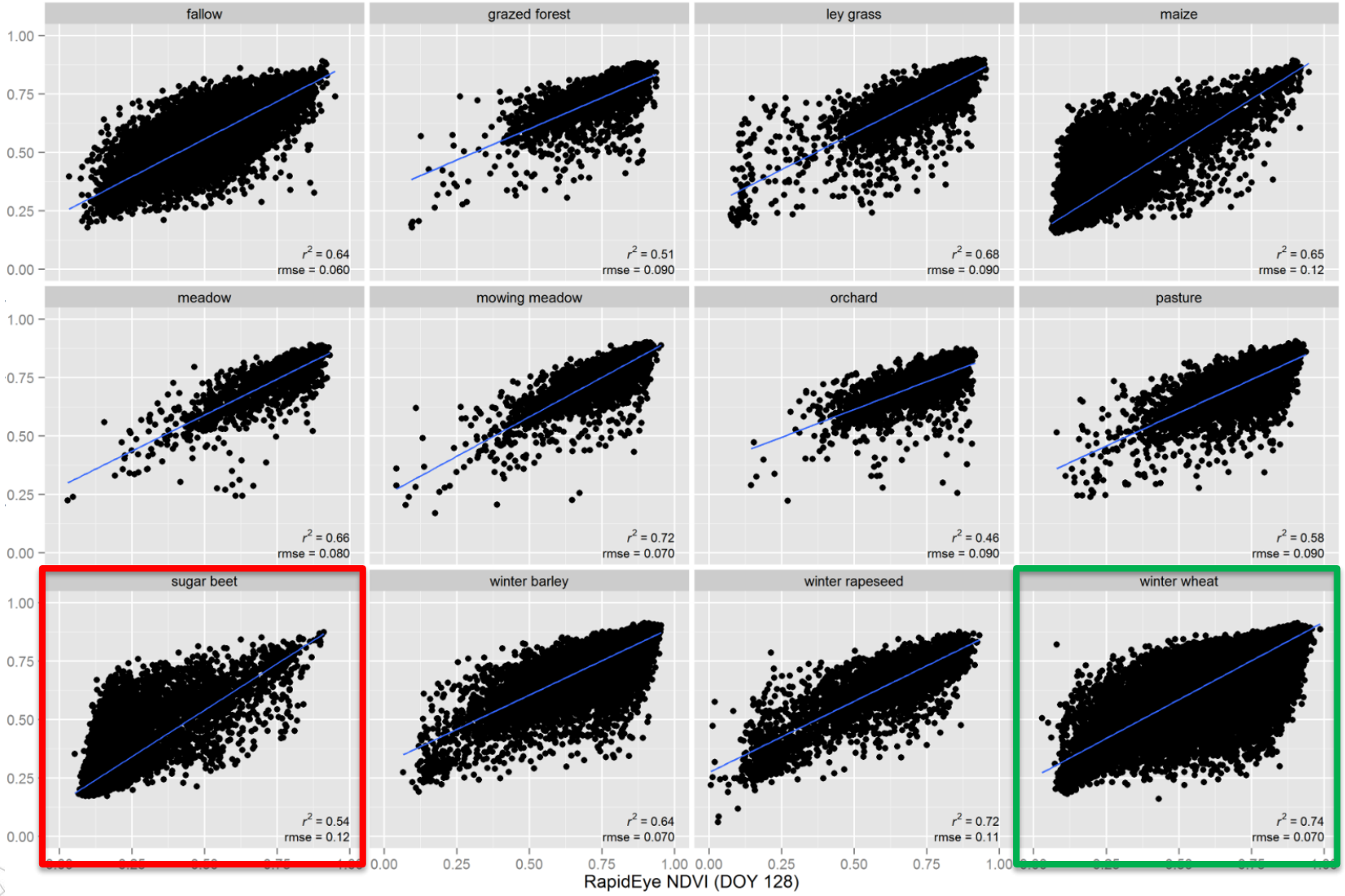
Month	MODIS	Landsat 5/7 image (DOY) utilized for STARFM	RapidEye image (DOY)	Temporal distance (DOY)
March	Daily product	112	66	46
April			108	4
			114	2
May		128	125	3
			128	0
June			155	27
			157	29
July		208	238	30
August				
September		272	245	27
			264	8
October		288	317	29
November			332	44
			333	45

Method (STARFM)

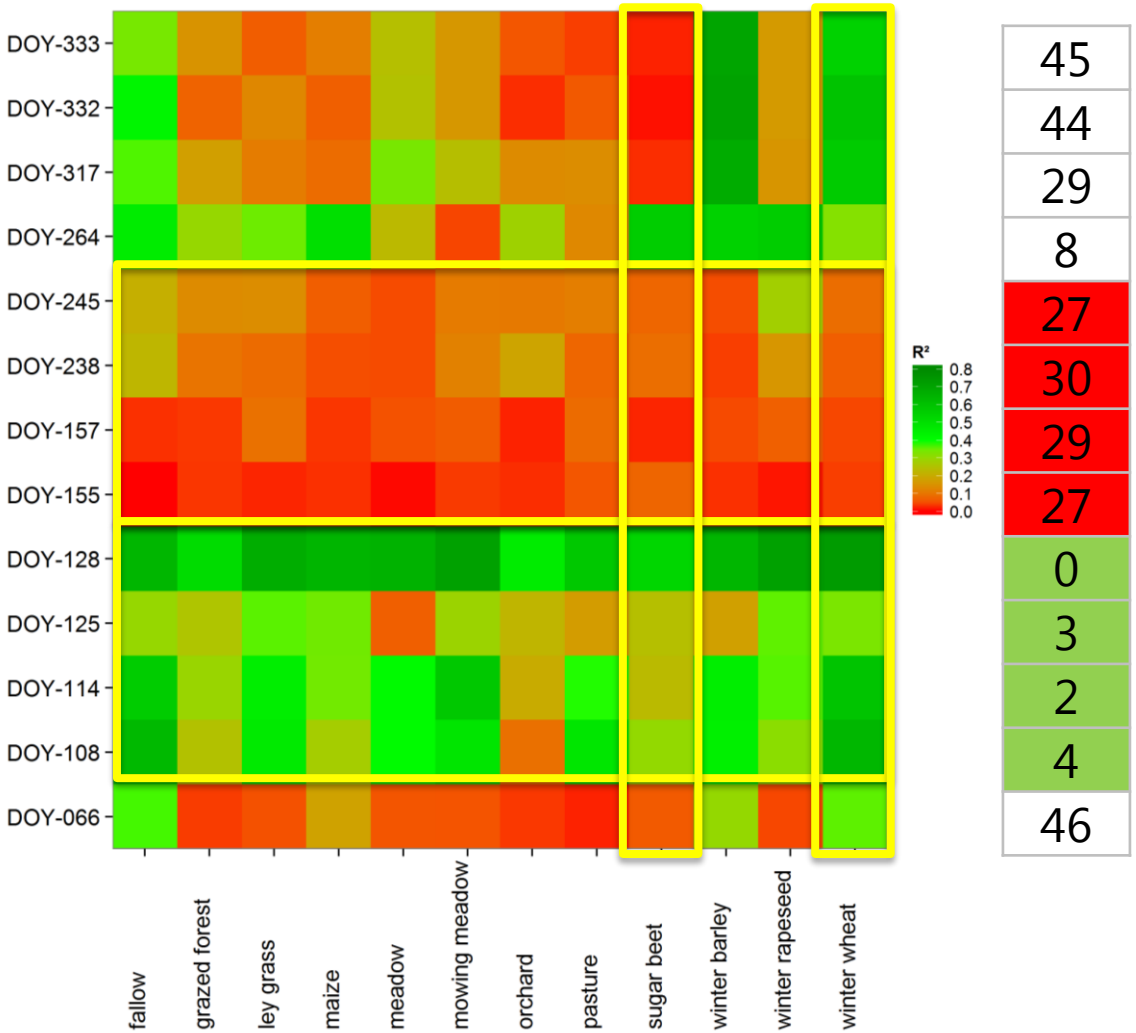


F. Gao, J. Masek, M. Schwaller, and F. Hall, "On the blending of the Landsat and MODIS surface reflectance: Predicting daily Landsat surface reflectance," *Ieee Transactions on Geoscience and Remote Sensing,* vol. 44, pp. 2207-2218, Aug 2006

Relation between synthetic Landsat and RapidEye (DOY 128)



Comparison of the synthetic scenes



45
44
29
8
27
30
29
27
0
3
2
4
46

Results depend on the date

Results depend on the crop type

Conclusion

two variables influence the quality of a synthetically derived time-series significantly:

a) the **pairing date** of a synthetic scene should not deviate strongly from the date of interest within the time-series.

b) **Classes with a stable phenological development** can be predicted with a higher precision compared to classes with rapid changes mostly due to multiple harvest or swath per year.

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Questions?

Michael Förster, Markus Möller, Feng Gao, Tobias Schmidt, Philipp Gärtner, Birgit Kleinschmit

Herzlichen Dank. Thank you.